

## REGISTRATION FORM

**THIS IS A REGISTRATION FORM FOR HOST INSTITUTIONS WANTING TO ESTABLISH A DIOSCURI CENTRE OF SCIENTIFIC EXCELLENCE.**

**1. Research institution data:**

Łukasiewicz Research Network – PORT Polish Center for Technology Development,  
Sieć Badawcza Łukasiewicz – PORT Polski Ośrodek Rozwoju Technologii  
Stabłowicka 147, 54-066 Wrocław, PL

**2. Type of research institution<sup>1</sup>:**

Institute of Łukasiewicz Centre

**3. Head of the institution:**

Dr. Andrzej Dybczyński, Director

**4. Contact information of designated person(s) for applicants and the NCN:**

Beata Lubicka, International Project Specialist, beata.lubicka@port.org.pl, tel. 727665560, Sieć Badawcza Łukasiewicz – PORT Polski Ośrodek Rozwoju Technologii ul. Stabłowicka 147, 54-066 Wrocław, PL

**5. Research discipline in which the strong international position of the institution ensures establishing a Dioscuri Centre:**

Materials

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<sup>1</sup> As specified in “Addressees of the call”

**6. Description of important research achievements from the selected discipline from the last 5 years including a list of the most important publications, patents, other:**

**a) Selected Publications:**

- 1) **S.K. Kabali, M. Kondratowicz, T. Lis, P.J. Chmielewski, J. Cybińska, et al.** *Lemniscular [16]cycloparaphenylene: a radially conjugated figure-eight aromatic molecule*. Journal of the American Chemical Society, 2019, 141, 7421-7427, IF: **14.695**, [10.1021/jacs.9b01797](https://doi.org/10.1021/jacs.9b01797)
- 2) **R. Petrus et al.**, *Magnesium and zinc alkoxides and aryloxides supported by commercially available ligands as promoters of chemical transformations of lactic acid derivatives to industrially important fine chemicals*, Coordination Chemistry Reviews, Vol. 396, (2019), Pages 72-88, IF **13.476**
- 3) **M. Navakouski, H. Zhylitskaya Halina, P.J.Chmielewski, T. Lis, J. Cybińska, M. Stępień** *Stereocontrolled synthesis of chiral heteroaromatic propellers with small optical bandgaps*. Angewandte Chemie-International Edition, 2019, 58, 4929-4933, IF: **12.257**, [10.1002/anie.201900175](https://doi.org/10.1002/anie.201900175)
- 4) **K.Prorok et al.** *Energy Migration Up-conversion of Tb<sup>3+</sup> in Yb<sup>3+</sup> And Nd<sup>3+</sup> Codoped Active Core/Active-Shell Colloidal Nanoparticles*, Chemistry of Materials (2016) 28, 7, 2295-2300, IF **10.159**,
- 5) **Zhylitskaya Halina, Cybińska Joanna et al.**, *Bandgap engineering in  $\pi$ -extended pyrroles : a modular approach to electron-deficient chromophores with multi-redox activity*. Journal of the American Chemical Society, 2016, 138, 11390-11398, IF: **13.858**, [10.1021/jacs.6b07826](https://doi.org/10.1021/jacs.6b07826)

**b) Selected patents:**

In cooperation with 732 scientists from Wrocław and Poland, 152 Research & Development projects have been implemented at ŁUKASIEWICZ – PORT in the nano and biotechnology fields. As the result, 95 Polish and 30 European patent applications have been prepared. So far 72 patents have been granted including 26 European and 4 American ones. Exemplary patents in the area of Materials: EP3008734, X-ray memory as well as its use, pending - P.415147, Method of producing a microfluidic channel for fluorescence microscopy on a chip - P.428721, Method for producing planar photonic two- and three-dimensional structures - PL227186, Method for gas detection and location and the system to execute this method - PL222531, A method and system for color marking of metals - PL224641, Al InGaN-based superluminescent diode - PL218578, Luminescent material and the use thereof - PL218302, A method of manufacturing foamed, amorphous, non-flammable insulating materials - PL229185, Method for producing semi-transparent luminescent layer doped with ions rare-earth elements and the luminescent layer, pending: - P.412006, A method for the functionalization of luminescent crystallites of NaYF<sub>4</sub> - P.415133, A method of synthesis and purification of gold nanoclusters with fluorescent properties and their application for biomolecule labeling.

- c) Scientific career:** since 2015 the seven habilitations were achieved thanks to realizing PORT's scientific projects and by ŁUKASIEWICZ – PORT researchers.

**d) Other scientific achievements:**

- Award for Prof. D. Hommel – the Scientist of the Future Polish Award of Smart Development 2019.
- BRUSSELS INNOVA International Fair: 1) Gold medal with distinction "Polymer microstructural fibers" (Prof.W.Urbanczyk), 2) Silver medal "Electromagnetic isolation pianosilicate" (Prof.D.Hreniak), 3) Silver medal – "microporous material for fibers and foil" (Prof.J.Janicki).
- Invited lectures of Prof. Shuji Nakamura (Nobel Prize 2014) and Prof. Shin-ya Koshihara, (winner of the Humboldt Research Award 2014).
- Co-organization (with INTiBS PAN) of the 1<sup>st</sup> Conference and Spring School on Properties, Design and Applications of Upconverting Nanomaterials 2016, Wrocław.
- Organization of the international REMAT Conference (2015) and Co-organization the International Conference on Luminescence in the field of geology, rare earth, luminescence for >700 scientists in total.

e) **Prizes for young scientific researchers:** Gold medal in Chemistry given by Physical Chemistry Institute PAN for 2019 to student Kacper Prokop finalist.

**7. List of no more than 3 important research projects from the selected discipline awarded in national and international calls to the institution in the last 5 years (title, name of PI, source of funding, amount of funding):**

- 1) **NCBiR Polish-Berlin call in Photonics - PioneerGaN True vertical GaN high speed switching transistors for direct diode laser driving** in cooperation with Ferdinand-Braun-Institut, Sentech Instruments GmbH, Seen Semiconductors Ltd., financed from bilateral national funds for Polish-Berlin call in Photonics, the total amount of €0,8 mln. The Principal Investigator Prof. Detlef Hommel. The project uses the chance to develop true vertical GaN devices on free-standing GaN substrates for direct laser pulsing. The project brings together cutting edge technological capabilities in Europe and allows for the development of new photonic systems. Pulsed diode laser systems offer the advantage to combine highly intensive laser light while maintaining high beam quality. This is an important prerequisite for many new optoelectronic systems for example in LIDAR (Light Detection And Ranging) or spectroscopy applications, for example in medicine. Missing link of such systems has been the non-availability of fast semiconductor switches which are specially adapted to the diode laser itself in order to provide extremely short but highly intensive laser pulses. PioneerGaN exactly addresses this topic and develops fast switching GaN transistors with vertical device architecture which can be adapted to the design of diode lasers and integrated with the same in a hybride manner. To get such devices realized it will be indispensable to merge the respective expertise of the Polish and German partners along with the proposed cluster strategy. This will significantly strengthen the technological skills of each of the partners and will create a world-wide competitive cluster. The Market analysts forecast that those devices should have the capability to revolutionize power electronics in the time frame of 4 to 6 years from now and could for instance be applied in highly efficient, low weighted on-board chargers for future full electric vehicles, However, the possible application of vertical GaN FETs is much broader.
- 2) **FNP Team Net - Hybrid sensor platforms of integrated photonic systems based on ceramic and polymer materials**, (PI: **Alicja Bachmatiuk**, PhD, DSc) is financed from ERDF by the Foundation for Polish Science in amount of €3,15 mln for (2019-2022).  
Main goal of the project is to create a research network of facilities specialized in integrated optics. In this project we propose the creation of a competence integration mechanism and an universal platform based on newly explored hybrid materials. Basis of these materials are going to be silica compounds with addition of e.g. TiO<sub>2</sub>, SnO<sub>2</sub>, used as structural matrixes, polymer coatings with additives (active or protective layers), organic and active two-dimensional materials such as transition metal dichalcogenides, graphene hybrids and boron nitride. All of those materials demonstrated unique structural, optical and electric properties in previous studies. Project will involve production and characteristics of materials, technology, design and creation of active and passive elements.
- 3) **FNP Team Tech - New efficient deep-UV emitters for Life Science Application**, this prestigious project is financed from ERDF by The Foundation for Polish Sciences, the amount € 0,83 mln. The Principal Investigators are **Prof. Detlef Hommel** and **Prof. Robert Kudrawiec**. This Team-Tech is aiming to develop the technology of efficient UV-LED emitters, which will be done in collaboration with industrial partner (Philips Lighting Poland). Works on UV-LEDs are motivated by many applications of UV emitters including the air and water purification. Results obtained within this Team-Tech project especially concerning novel ideas on p-doping should also find their way to the next generation of shorter wavelengths InGaN/GaN based blue-green emitters. In the context of Team-Tech call it is important to underline that researches of InGaN LEDs after the inventions of

Shuji Nakamura have opened new sectors in the industry i.e. the energy efficient, Solid State Lighting (SSL). We are fully convinced that the same story will come up with UV emitters including LEDs and in the future UV laser diodes (LDs). The last ones are much more challenging and will be not developed within this project but they can be developed in a longer time perspective by the research team created within this project.

## 8. Description of the available laboratory and office space for the Dioscuri Centre:

Łukasiewicz Research Network – PORT Polish Center for Technology Development is a unique institution, built on the largest infrastructural project in Poland in the R&D area with over 23.000 m<sup>2</sup> of fully-equipped laboratory and office space. In the accredited laboratories, a number of tests and analyzes can be performed, they relate to both qualitative tests confirming the identity of organic compounds or chemicals, including medicines, dietary supplements, food products and various types of chemical synthesis products; and quantitative research, which involves, determining the purity of organic compounds by NMR. Electron Microscopy Laboratory is the only unit in Poland offering a unique method to determine the purity of standards or chemical reagents in a wide range of contents, as well as in the pharmaceutical industry to identify known and new active substances.

### **For the Dioscuri ŁUKASIEWICZ - PORT will offer:**

- a) Open-space laboratories dedicated for establishing new research groups
- b) Modern, fully furnished office ranging from 15 to 45 m<sup>2</sup>
- c) Fully equipped, specialized laboratories, dedicated for organic and inorganic synthesis, clean synthesis and characterisation of novel materials with special properties, mainly Laboratories:
  - I. Electron Microscopy,
  - II. Polymer Materials,
  - III. Optical Spectroscopy,
  - IV. Functional Materials Synthesis,
  - V. Materials Technology,
  - VI. Structures And Materials Research,
  - VII. Laser Technology.

### **Services we offer in our laboratories:**

- Designing, synthesis and bio-functionalization of materials with luminescent properties and a comprehensive characterization of their structure and composition. These materials in the form of powders, solutions, or thin films are applicable in different areas, from modern lighting (e.g. of LED type), through anti-counterfeiting marking, to advanced medical technologies. It is possible to synthesize organic compounds, rare earth based complexes and materials, as well, as nanoparticles. Full spectroscopic characterization and quantitative analysis of obtained substances can be made.
- Fabrication of epitaxially grown nitride materials for optical, electronic and magnetic applications as well as for basic research. Development and supply of optically active and magnetic materials on substrates up to 4 inch diameter. State of the art in-situ characterization tools provide high reliability and reproducibility of sample properties. Analysis can be done after growth or on any externally introduced sample.

## 9. List of the available research equipment for the Dioscuri Centre:

Below listed equipment will be available to the Dioscuri Leader accordingly to the scope and Research Agenda for the Dioscuri Centre.

### I. Structures And Materials:

Molecular beam epitaxy system (MBE) System  
Metal-organic chemical vapour deposition (MOCVD) System  
Atomic force microscope (AFM)  
X-ray photoelectron spectroscopy (XPS)  
WAXS/SAXs X-Ray diffractometer (Pananalytical Empyrean)  
Single crystal diffractometer (Agilent technologies)  
SEM/FIB microscope with EDS (FEI Helios Nanolab 450HP)  
TEM microscope (FEI Tecnai G2 X-Twin)  
HR-TEM Microscope (FEI Titan G2 60-300) and spectrometer EELS  
Devices and accessories for sample preparation for light, scanning and transmission microscopes  
Micromachining system with picosecond laser, Micromachining systems with Excimer laser  
Micromachining system with fiber laser and CO<sub>2</sub> laser  
NMR 600MHz (Bruker), ICP-OES

### II. Optical Spectroscopy:

Fluorescence spectrometers (Edinburgh instruments)  
Spectrophotometers (Evo 300, Thermo Scientific)  
FT-IR Spectrometer (Nicolet is50, Thermo Scientific)  
Spectrometer MALDI Autoflex III TOF/TOF (Bruker)  
Atomic absorption spectrometer (SavantAAS, GBC)  
Microwave reactors  
High-pressure reactors for syntheses  
Glove boxes  
Automatic Soxhlet Extractor  
Spray dryer, Vacuum dryer  
Liophylizers, Homogenizers

### III. Polymer Materials:

Thermal analyzer (Netzsch STA 449 F1 Jupiter; Bruker FTIR Tensor 27; QMS Aeolos)  
High temperature dilatometer DIL (Netzsch DIL 402C)  
Thermal diffusivity analyzer LFA (Netzsch LFA 457 MicroFlash)  
Thermal conductivity analyzer HFM (Netzsch HFM 436 Lambda)  
Dielectric analyzer DEA (Netzsch DEA 288 Epsilon)  
Differential scanning calorimeter with modulated temperature MT-DSC (Mettler-Toledo DSC1)  
Thermogravimetric analyzer TG (Mettler Toledo TGA2)  
Dynamic-mechanical-analyzer DMA (Mettler Toledo DMA/SDTA 861)  
Thermo-mechanical analyzer TMA (Mettler Toledo TMA/SDTA1 LN 600 i TMA/SDTA 1 LF 1100)  
Physisorption analyzer (Micromeritics 3Flex)  
Chemisorption analyzer (Micromeritics AutoChem II)  
Goniometer OCA 35 (DataPhysics)  
Tensiometer DCAT11 (DataPhysics)  
Zetasizer Nano range analyzer (Malvern ZS)  
Aging tests chambers

#### **IV. Laser Technology:**

High precision ink-jet printer PiXDro LP50

High precision dispensing robot Fisnar F4200N

Laboratory Setup for inks fabrication

System for current-voltage measurements

System for measurement of spectral response of solar cells

System for electrochemical measurements

Tabletop system transmission and reflection of thin films

Ageing and UV chambers

Glove boxes

**10. List of the additional benefits (other than listed in call text) that the Institution declares to provide for the Dioscuri Centre (i.e.: additional funds, personal benefits, other):**

PORT's strategy and organizational rules facilitate the high degree of novelty approaches in research and efficient transfer of research results into innovative future technologies. The location of PORT is absolutely unique; in historical, green **Campus Pracze**: 11 000 m<sup>2</sup> of lab space on 27 ha of campus area, 100 ha of an area surrounding the Campus, intended by the city of Wroclaw for R&D investments, 13 km from the centre of Wroclaw, **dedicated parking lot**, and an old park nearby, **excellent communication** thanks to the proximity of motorway bypass, airport and train station **100 meters from the campus**.

In order to best facilitate and increase the success of sustainable operation of the Dioscuri Centre **PORT declares the following organizational and scientific benefits for the Leader:**

- a) Attractive relocation package for the leader and the family including: travel costs, the free Polish language course, free health insurance and housing allowance and free canteen access.
- b) Supporting the on-boarding installation and start-up package for the lab.  
The organizational support from HR in the adaptation to the new environment. The personal assistance to help understanding the organization, HR will assist in relocating, setting of formalities in Polish offices, banks and other institutions, finding accommodation and leisure activities.
- c) Guarantee authority to publish as senior author and invite as co-authors those who have contributed substantially to the work;
- d) Support in selection and supervision of the other team members, in line with the profiles needed to conduct the research and in accordance with Code of Conduct for the Recruitment of Researchers HR excellence rules and institution management practices;
- e) Organization of international science and business oriented conferences as well as science promoting events as Researchers' Nights.
- f) The organization support in obtaining the international grants from Horizon Europe as well as local, Polish funding programs. Supporting of Submitting applications, building scientific collaborations and relations with Hi-Tech SMEs. eg. XTPL, SDS Optic, Advanced Graphene Products, WABCO.
- g) Project management; financial reporting, project administration according the implemented methodology (PRINCE2 modified with the institution's own solutions) at every stage of a project. The support includes also documentation of the progress (milestones and expenses) the risks management, contingency plans, and application of the adequate financial procedures.
- h) Commercialization of research results, building the IPR portfolio of complementary projects and creating a foundation for innovative application solutions, long-term investment based on demonstrators and cooperation with big companies eg. MoU with LG Electronics, PCC Rokita, Schumacher Packaging. Joint ventures according to the concept of an industrial partner eg. contract with PWPW (*Polish Security Printing Works*) S.A. on Development of innovative technology of personalization of polycarbonate blanks of state documents.
- i) The Institute Council with a senior advisory role composed of 12 international members. The Council will be, representing business, academia and public domain. As ŁUKASIEWICZ - PORT aspire to build world-class institution, Council shall represent two major fields of the Institute's areas of interest - biotechnology and materials engineering.

**11. Other information about the internationalisation of the research institution, international researchers employed at the institution, the availability of English language seminars etc.:**



- ŁUKASIEWICZ - PORT (former Wrocław Research Centre EIT+) has been seeking international dimension by gaining international staff. Internal (English language) scientific seminars and invited lecture seminars are carried out weekly. Representatives of each of the 4 scientific centers cover topics of biotechnology, nanotechnology and engineering. Most of scientific groups leaders used to work abroad worldwide for a few years, before joining ŁUKASIEWICZ - PORT and invite their colleagues as guest lecturers. Internal scientific seminars and invited lecture seminars are presented in English weekly.
- Prof. Detlef Hommel from University of Bremen has been invited to build the Nanotechnology Department in WRC EIT+ since 2019 ŁUKASIEWICZ - PORT and coordinate formulation of scientific groups. Dr. Gerd Kunert from the University of Bremen was involved in launching the Laboratory of Epitaxial Semiconductor Compounds. Julian Stoever, PhD student, conducted research into a doctoral thesis based on the PioneerGaN project. In 2016, as part of cooperation with the IMEC Interuniversitat Micro-Electronics Centrum, the project "New nitride based materials and hybrid solutions for short-wavelength technologies in industrial application" was prepared for the FNP competition for the International Research Agenda worth PLN 35 million. The application has passed to the second stage of the assessment of international experts. In 2019 Prof. Hommel submitted the application for the ERC Advanced grant.
- Other young researchers coming from abroad: Daria Hlushchenko MSc. – Process Engineer, Dr. Jean-Guy Rousset, Functional Materials Synthesis, Niels Andre PhD student.
- From 2015 ŁUKASIEWICZ - PORT has been actively participating in two COST networks:
  - COST The European Upconversion Network From the Design of Photon-upconverting Nanomaterials to (Biomedical) Applications - CM1403 (Prof. A. Bednarkiewicz)
  - COST Action MP 1307: stable Next-Generation Photovoltaics: Unraveling degradation mechanisms of Organic Solar Cells by complementary characterization techniques (StableNextSol) (Dr. eng. Andrzej Chuchmala)
- In 2017 Dr. hab. Alicja Bachmatiuk invited to the Laboratory of Electron Microscopy, Dr. Sandeep Gorantla of the University of Oslo, who obtained the finances for his research from the Polonez-1 program of the Polish National Science Centre and realizes the project on "Atomic scale study of emerging UV-light LEDs by advanced transmission electron microscopy".
- In 2019 Dr. Róża Maria SZWEDA moved to PORT from Université de Strasbourg, CNRS, Institut de Science et d'Ingénierie Supramoléculaires to realize project: Sequence-defined macromolecules of controlled folding. She is also a scientific expert for The National Centre for Research and Development.
- ŁUKASIEWICZ - PORT has gained the experienced in European science networking and the Cooperation on the European scale through H2020 initiative EIT European Institute of Innovation and Technology and KIC RAW Materials (Knowledge Innovation Community) - The EIT's innovation partnership that bring together businesses, research centers and universities. The institute has been involved in the application as a co-founder of the consortium of 116 partners and the founder of the Eastern Collocation Centre of KIC RM located in ŁUKASIEWICZ - PORT.
- RawMaterials Academy was initiated by EIT KIC RM. The innovative educational projects are conducted as part of the Academy, which are addressed to doctoral students, students, industrial partners, specialists from the raw materials sector and a broad society. Training, workshops and conferences support new ways of teaching by linking academia environment, research organizations and industry.
- WRC EIT + ŁUKASIEWICZ - PORT was a Partner of the 4th edition of the MIT Enterprise Forum Poland.

